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Regression Discontinuity Design – A suitable method for evaluating the effect of state aid on renewable energy deployment through auctions?

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EXTENDED ABSTRACT

By 2021, 19 Member States of the European Union (EU) have implemented auctions to determine the allocation and levels of support for large-scale renewable energy (RE) projects. In RE auctions, project developers compete against each other by submitting the level of support they need to realise their projects (i.e., the bid price). The auctioneer, in most cases the government or a governmental agency, typically sorts the submitted bid prices in ascending order and awards the projects until the auctioned volume is reached. The European Commission typically requires the Member States to evaluate, among others, the direct incentive effect of state aid, in this case, the allocated support to RE projects. In other words, Member States need to assess whether the support payments led to the awarded RE projects being realised, and whether the implementation would have been less likely without state aid.

Introduction

For the required state aid evaluation of the Member States' support schemes, the European Commission proposes, among other methods, the "regression discontinuity design" (RDD), a quasi-experimental approach that investigates the causal impact of a treatment/support on beneficiaries. This is done by comparing beneficiaries and non-beneficiaries close to a certain threshold, which determines if the treatment is provided or not. To date, only few Member States have conducted an evaluation of their RE support schemes, usually without employing the RDD. Thus, the RDD has not been applied, either in political or academic settings. Therefore, this study answers whether the RDD is a suitable method for evaluating the effect of state aid on renewable energy projects in auction-based support schemes.

Methodology and data

We conduct the RDD by examining whether the dependent variable, i.e., the realisation of a project, shows a discontinuity at the threshold, i.e., the highest awarded bid price. Submitted bid prices below this threshold are awarded and are consequently supported (the treatment group), while submitted bid prices above the threshold are not awarded and do not receive any support (the control group). Thus, by comparing the treatment group with the control group, we can assess if the support had a significant effect on the realisation of the projects. Bidders cannot select whether they are in the treatment or control group, which is why we can assume that around the threshold, the allocation into the groups is more or less random and thus that the projects do not differ (besides the treatment). Thus, we take only part of the sample into account, specifically, projects that bid close to the threshold (highest awarded bid). We estimate this model using a logistic regression due to the binary character of the dependent variable.

In a first step, we perform two country case studies (Italy and Greece) for which detailed auction bid data are available, including auction rounds from 2012 to 2019. In particular, the data consists of the submitted bids

(price and project capacity), information on whether the bids were awarded support, and whether the projects were realised. We conducted the RDD for both individual auction rounds and aggregated over all conducted auctions. In a second step, we test the method further by conducting several analyses with fictitious auction results to check under which circumstances (e.g., various sample sizes or different bandwidths around the threshold) the RDD produces robust results.

Results

The RDD could be applied to the Italian onshore wind auctions but not to the Greek solar PV and onshore wind auctions. The difference in the data is that none of the Greek auction rounds contains realised projects in the control group (i.e., the non-awarded projects). Another challenge in the Greek data is that several bids below the threshold were not awarded in some auction rounds due to peculiarities of the Greek auction design.

The results of the Italian onshore wind auctions suggest a marginal effect of treatment between 77 and 89 percentage points at bandwidths between 0.1 and 0.3 ct/kWh around the threshold. Bandwidth 0.1 ct/kWh includes 18 data points and still produces significant results since it contains one non-realised project in the treatment group and one realised project in the control group. These findings provide two important takeaways for this study. Firstly, the RDD is applicable even with a minimal number of data points if the data has at least one outlier in the treatment and control groups. Secondly, the support of RE projects through auctions has a significant effect on the deployment of RE projects. Receiving support increased the probability of realising the project in Italy by more than 70 percentage points, and the number of projects that were realised without support was less than 1%. Thus, we can assert that the support was necessary for the deployment of RE in Italy.

The analyses using the fictitious data support these findings. Due to the properties of the logistic regression, the RDD leads to a significant effect of the treatment on the realisation if 1) the treatment group (awarded projects) contains at least one non-realised projects, and 2) the control group (non-awarded projects) contains at least one realised project within the considered bandwidth. This finding is independent of the sample size or other data characteristics.

Conclusion & discussions

The results of the analyses using fictitious data and the country case studies have shown that the RDD can, under certain circumstances, be an adequate method for evaluating the direct incentive effect of state aid on the deployment of RE through RE auctions.

However, it depends on the structure of the auction data if the RDD can be applied. The RDD is applicable to the Italian onshore wind auctions and provides significant effects and thus useful evaluation results. Our analysis has shown that the RDD is not applicable to the Greek solar PV and onshore wind auctions since none of the Greek auction rounds contains realised projects in the control group. The analyses with fictitious data support the finding that at least one project of the treatment group needs to be non-realised and one project of the control group needs to be realised to observe a significant effect of the treatment. This phenomenon and especially its independence of sample size can also be observed in the RDD results of the Italian auctions.

Based on our results, we have identified the following requirements for an evaluation of RE auctions using an RDD: Firstly, the RE auction must result in a treatment group of awarded bids and a control group with bids that have not been awarded in this auction rounds. This means that the assessed auction round needs to be oversubscribed. Secondly, the RE auction must award the bids based on the bid price only to allow the application of an RDD. Thirdly, both the treatment group and the control group must contain realised and non-realised projects close to the threshold, i.e., the highest awarded bid. If these conditions are met, the RDD can be a suitable method for evaluating the effect of state aid allocated through RE auctions on RE deployment.